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ABSTRACT

One of three publications of the Research on Equitable Access to Technology (REAT) project, this practitioner's handbook is designed to assist educators in the design and implementation of computer instruction programs for underserved groups of students, including low-income, minority, low-achieving, limited-English speaking, female, and rural students. After reviewing the findings of research on equal access to computers, six fictional programs specifically designed to provide computer access to all children are described; these programs are based on similar programs at real schools. Hardware and software issues as they relate to the issue of equitable access are then explored, and the benefits of equitable access are described. Finally, recommendations to communities and schools for bringing about equitable access are provided. A list of 37 references is provided as well as descriptions of the three REAT publications and two Far West Laboratory (FWL) reports of related interest. Additional selected resources are also listed, including two non-FWL publications and eight organizations concerned with issues of equitable computer access. (EW)

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COMPUTERS FOR ALL CHILDREN:

A HANDBOOK

FOR PROGRAM DESIGN

**Pamela Sharp
Janet Crist-Whitzel**

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**Far West Laboratory for
Educational Research and Development**

November 1985

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COMPUTERS FOR ALL CHILDREN:
A HANDBOOK FOR PROGRAM DESIGN

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1855 Folsom Street
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November 1985

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Two others played key roles in the development of this handbook. Nancy Ellis provided invaluable help in guiding us to additional sources of information. Jean Barker practiced her editing arts to smooth the manuscript into its finished form.

Michael Hunt, Marie Paul, Rebecca Becker, and Jessica Paul all helped with various phases of the project.

We owe our greatest debt to the many colleagues and educators in California, Nevada, and Utah who provided us with information on their programs and invited us to visit them. This handbook really belongs to them because it is based on their collective experience and fund of knowledge.

We also thank the National Institute of Education for funding this work and our Project Monitor, Dr. Oliver Moles, for his guidance and encouragement along the way. The authors take responsibility for the contents of this handbook.

TABLE OF CONTENTS

Introduction	i
Publications Research on Equitable Access to Technology and Related Work	iv
Chapter One What Do We Mean by Computers for All Children?	1
Chapter Two What Do Programs for All Children Look Like?	8
Chapter Three What About Hardware and Software?	23
Chapter Four What Do Children Need for Equitable Access?	38
Chapter Five What Can Schools and Communities Do to Establish Computer Programs for All Children?	47
Bibliography	52
Other Selected Resources: Equitable Access to Computers . .	55

INTRODUCTION

The issue of equitable access to computers in education--computers for all children--is critical to the educational community. Over the past two years it has been increasingly recognized that certain groups of students (minority, female, low-income, low-achieving, limited-English speaking, rural) are missing out on the opportunities afforded by computer instruction in our nation's schools (Arias, 1984; Crist-Whitzel, 1985; Karoff, 1984; Marrapodi, 1983).

Study after study has confirmed the existence of inequities for these groups in terms of both quantity (amount of computer use) and quality (type of instruction) of access to computers in schools (Anderson et al., 1984; Becker, 1983a, 1983b; Podemski et al., 1983). Students in affluent school districts are four times as likely to have computer access as students in the poorest districts (Anderson et al., 1984). Racial minority students are even less likely to have computer access (Becker, 1983a, 1983b). And advantaged students don't just have more computer instruction--they also use computers in more advanced ways. High-achieving students often learn programming and higher level applications, while low-achieving students, when they do have access, tend to use the computer mainly for drill and practice. Thus, advantaged students learn to control the computer;

disadvantaged students are controlled by the computer (Arias, 1984; Becker, 1983a, 1983b; Karoff, 1984).

Why is it so important for all children to have access to computers? Some researchers have estimated that by 1990 eight out of ten jobs will require computer knowledge to some degree (Fisher & Finkel, 1983; Frank, 1983). Although these figures have been disputed (Levin & Rumberger, referenced by Siegel, 1983), there is no doubt that if young people lack computer skills, their ability to obtain jobs in the information age will be hindered if not prevented.

Educators are concerned that the documented inequities in computer access will not only have far-reaching implications for the future workforce, but also widen the already existing gap between the "haves" and the "have nots." The underserved groups will be relegated to a permanent underclass, seriously damaging the nation's social and economic well-being (Anderson et al., 1984; Castillo, 1984; Euchner, 1983; Karoff, 1984; Mace, 1983; TERC, 1983).

This practitioner's handbook has been written to help educators design and implement computer instruction programs for underserved groups of students. It is part of a larger effort, the Research on Equitable Access to Technology Project, funded by the National Institute of Education and conducted at Far West Laboratory to identify, document, and disseminate vital information about programs to increase access to microcomputers

by these target groups. Descriptions of this handbook and the other publications issued in this effort and work of related interest by Far West Laboratory are included on the following two pages. Selected resources from other institutions dealing with equity issues and technology in education will be found following the bibliography at the end of this handbook. Readers may wish to avail themselves of those resources.

PUBLICATIONS

Research on Equitable Access to Technology and Related Work

Research on Equitable Access to Technology Project:

Computers for All Children: A Directory of Programs Fostering Equitable Access to Computers. Janet Crist-Whitzel, Pamela Sharp, and Nancy Ellis (November 1985).

This resource directory provides descriptions and contact persons for over 50 computer education programs (most of them in schools) identified in a region-wide survey of Northern California, Nevada, and Utah as effective programs for various underserved groups of students (including minority, disadvantaged, low-achieving, rural, female, and limited English-speaking). Entries for each program include a general description with goals, objectives, and target students; general information about the school and the program; types of computer activities; equipment and software; and results of the program if available. For many programs, factors that seemed to affect the implementation process are also listed. The document includes a description of the REAT project and the survey process, a brief overview of access issues, references, and additional selected resources.

Computers for All Children: A Handbook for Program Design. Pamela Sharp and Janet Crist-Whitzel (November 1985).

This guidebook is designed for educators wishing to implement computer education programs for underserved students (including minority, disadvantaged, female, low-achieving, limited English-speaking, and rural). The handbook provides portraits of a variety of effective programs; a review of equitable access issues and studies; an overview of hardware and software needs; a focus on what children need to have a successful and equitable learning experience with computers; and a spotlight on what schools and communities can do to ensure equitable access to computers. Lists of references and selected resources are included.

Computers for All Children: A Literature Review of Equity Issues in Computer Utilization. Janet Crist-Whitzel (November 1985).

This report outlines equity issues and documents lack of access to technology in both quantity and quality of use for underserved students (including disadvantaged, minority, limited English-speaking, female, low-achieving, and rural students). The report also draws implications for computer education programs from literature on effective instruction and outlines implementation issues. References are included.

Other Related Publications:

Achieving Equity: Student-Led Computer Training. Paper presented at the annual meeting of the American Educational Research Association, New Orleans (1984). (ERIC document, ED 248 848).

This paper describes the background, procedures, and operation, and evaluates the results of a demonstration project of the Center for Research on Equitable Access to Technology in Education (CREATE) at the Far West Laboratory using computer-literate high school students to teach and tutor disadvantaged and minority high school students as an approach to achieving equitable access to computers for those students. Classes described and evaluated included an ethnically-mixed group of students from one inner city high school; a group of all Hispanic students from a second inner-city high school; and a group of all Samoan students from various high schools, some of whom were dropouts. The program was successful for these groups of students who learned programming, developed their own computer programs, and had positive attitudes toward the class, the student trainers, the teaching strategy, and computers. (49 pages, including references and tables).

Effective Teaching for Desegregated Settings: A Review and Application of Research. Janet L. Crist-Whitzel (1981).

This report was produced for the Multi-Ethnic School Environments Project at the Far West Laboratory and provides an overview of the research on effective instruction and its implications for disadvantaged and minority students. (66 pages, including references).

**COMPUTERS FOR ALL CHILDREN:
A HANDBOOK FOR PROGRAM DESIGN**

CHAPTER ONE

What Do We Mean by Computers for All Children?

When we talk about computers for all children we are talking about equitable access to computers. This means:

- o Equal amounts of computer use, regardless of sex, economic status, ethnic background, school achievement, and geographic locale.**
- o Appropriate activities for each special population.**
- o A full range of benefits of computer use including the development of both basic and higher order cognitive skills as well as computer-specific skills.**
- o Opportunities for all children to recognize and receive social recognition for special skills and knowledge developed through work with computers.**

Unfortunately, equitable access is not always available in schools. [Most of the following highlights in this chapter are taken from Crist-Whitzel (1985), which provides a more complete literature review of access issues.]

- o When comparing the 12,000 wealthiest with the 12,000 poorest districts in the country, the National Assessment**

of Educational Progress in 1984 found that affluent students are four times as likely as poor students to have access to computers (Anderson et al., 1984; Karoff, 1984).

- o Low-income schools in which minority students predominate have higher student-to-computer ratios than low-income schools with a white majority. This indicates that racial minority students have an added disadvantage over and above their low economic status alone (Education Daily, 10/31/83).
- o A 1982 National Education Association (NEA) survey of teachers found that a far higher percentage of teachers in suburban areas (41%) and small towns (28%) use computers in instruction than do teachers in rural (16%) or urban areas (15%).
- o More computers do not automatically insure equal access. When elementary schools acquire more computers, they do provide access to a greater number of their students. However, as secondary schools gain more computers, they provide more access time to about the same number of students as before (Becker, 1983a, 1983b).
- o Of 1,200 teachers responding to the NEA survey, 41% indicated that they did not believe there should be a school policy mandating that all students should have an opportunity to learn to use computers in the classroom.

- o Furthermore, as computers are purchased more and more frequently for use in schools by outside agencies such as local PTA groups, access to that equipment often falls under the control of these groups which may have special interests. In these cases, established school policy does not guide computer use.

Inequities in the amount of computer use exist outside as well as inside schools for disadvantaged and minority students.

- o Poor families are less able than affluent families to buy computers for use at home.
- o Students from poor families are less likely to participate in computer-related out-of-school activities as well. A 1982 survey of twenty-three summer computer camps found that 98% of the students enrolled in these camps were from upper- and middle-class families, and only 2% were from minority groups, mostly Asian (Hess & Miura, 1983).
- o Disadvantaged youths often have after-school jobs and responsibilities for siblings, which further reduce the amount of time they can spend with computers, even when computers may be available in after-school and summer programs.

There are disparities not only in the quantity of use but also in the quality of use by students who differ in social class and ability.

- o Many teachers feel that the learning of higher level cognitive skills on the computer should be targeted at high-achieving, gifted students.
- o When low-achieving and disadvantaged students are given access to computers, they participate mostly in remedial work, which focuses on building basic skills through drill and practice uses (Arias, 1984; Becker, 1983a, 1983b; Brookover & Lezotte, 1981; Cardenas, 1983; Karoff, 1984; NBSA, 1983).
- o Schools that buy computers for their disadvantaged students with certain federal funds are required to use the computers for basic skills rather than for the acquisition of higher level skills (Castillo, 1984).
- o Very little instructionally sound software has been developed to meet the special needs and interests of limited-English speaking, disadvantaged, or female students.
- o Low-achieving, disadvantaged, and minority students too often learn to do only what a computer tells them to do, while advantaged students learn to tell the computer what to do (Watt, quoted by Cardenas, 1983, p. 3).

Sex differences, self-image, and peer pressure also contribute to inequitable computer access.

- o Boys are more aggressive than girls in seeking computer opportunities and are more likely to learn programming, while girls are more likely to learn to use computers for such purposes as word processing (Campbell, 1983; Fisher, 1984; Hamilton, 1984; Kiesler et al., 1983; Marrapodi, 1983; Van Nuys, 1983).
- o Boys have more realistic expectations, tend to go beyond the information given, and seek help more often than girls (Linn, 1984).
- o Girls tend to blame failure on themselves more than boys do and quickly build an image of themselves as incapable of computer use (Linn, 1984).
- o Non-computer using students often view students deeply interested in computers as "nerds" and try to avoid acquiring that label for themselves.
- o Role models for computer use are usually male, and in advertising, computer use is most often set in an upper-class, male context (Marrapodi, 1983; Van Nuys, 1983).
- o When certain math courses such as algebra are required as prerequisites for programming courses, the participation of girls and many minority students is restricted. The more advanced or costly the level of involvement, the larger the gap between boys and girls.

Because of all these factors, serious computer-using students tend to be overwhelmingly white, male, and from higher socioeconomic families.

There is growing evidence that computer-based instruction can be academically beneficial to precisely those types of students who suffer the most from inequitable access.

- o In fifty-one separate studies of the effects of computer-based teaching in grades six through twelve, it was found that instruction via computer raised the performance of students in general as well as decreased the amount of learning time (Kulik, Bangert, & Williams, 1983).
- o The use of computers seemed especially effective for disadvantaged students, with positive effects found on attitudes toward subject matter, computers, and school (Kulik, Bangert, & Williams, 1983).
- o Even greater achievement effects are reported for younger elementary school children. It has been found that computer use has a positive influence on student performance and/or attitudes, including enhanced feelings toward self and a sense of personal control.
- o Researchers and teachers have also found that computer use enhances collaboration and cooperative learning among students. Children seem to work together more in solving problems on computers than in any other school activity

(Becker, 1983a; Bracey, 1982; Resnick, 1984; Ryba & Chapman, 1983).

- o Various forms of cooperative learning and peer tutoring have been effective in enhancing academic performance of black and Hispanic students and for reducing social distance, improving interracial and school-related attitudes, and fostering equal status interactions among students of different racial and ethnic minorities (e.g., Aronson et al., 1978; Crist-Whitzel, 1980; Slavin, 1978).

This handbook has been developed from the experiences of many educators who have recognized inequities of computer use and who want to provide the whole range of benefits for all their students. Many are successfully providing equitable access to computers in their schools and districts. They have also found out that computer use with their students is in fact fulfilling its promise. The aim of this handbook is to help others build programs that may meet different needs but have similar outcomes--equal access to computers and to learning for all children.

CHAPTER TWO

What Do Programs for All Children Look Like?

Programs that provide equitable access to computers are in some respects remarkably similar, but in other respects quite different. In this chapter, we will describe six programs at schools that exemplify in one way or another successful approaches to equitable access for all children. Although the names of the schools are fictional, the programs are similar to those at real schools that provide computer access for all children.

Loma Verde Elementary School

Loma Verde Elementary School is part of a peaceful green oasis in an otherwise bleak low-income neighborhood. Because the school is bordered by a city park, recess for students means playing touch football on grass under oak trees, waiting for a precious turn on the swings, or laughing with friends while climbing to the top of a traditional, iron pipe jungle gym. Seventy percent of the children at Loma Verde are Hispanic and fifteen percent come from other minority, limited-English speaking households.

The computer lab at Loma Verde School looks almost like an art room. On top of each of the computers is a brightly colored tissue paper flower with the work station number in the center.

Hanging from the ceiling are felt banners with simple, bold Mexican folk images, made by the students.

Twenty children, singly or in pairs, actively work on software chosen by their teachers to meet specific curricular objectives. Two assistants move among the children. One assistant stops for a minute to help a five-year-old choose an activity in a corner set up especially for kindergartners; then she moves back into the larger area, ringed with twelve computers all up and running. The assistants, like most of the children, are native Spanish speakers. Conversations are in both Spanish and English.

A timer issues a soft warning that the period is almost over. Students record their activities in a folder and, after a quick check by an assistant, either reboot or remove their diskettes. Excused individually, they press their way out the door through a line of eager learners waiting for their turn.

As the waiting group comes in, the assistants place individual children's folders next to their assigned computers. Students go right to their machines, boot the diskettes provided, and begin working. For this group of fifth graders, only part of one class, the classroom teacher has chosen software that will augment skills development in reading and math, predominately computer-assisted reinforcement activities. Students do not share machines, but rather work alone. Every fifth grader spends at least one half hour twice a week in the computer lab, working on basic skills.

The scene changes with the next group. A whole fourth grade class tumbles into the Loma Verde computer lab to work in pairs at the computers with problem-solving software. Like the fifth graders, these children come to the lab for one half hour twice a week. The children in the third grade, however, will spend double that amount of time in the lab and participate in two kinds of computer experiences every week: individual work on skills and group work on problem solving.

In the meantime, the kindergartners finish their activities and are replaced by others sent by their teachers. At noon, a small group of fifth graders comes to the lab to be trained to work with younger groups in first and second grade classrooms where shared computers are kept on carts. And before school the lab is buzzing with children who have scored below the forty-seventh percentile on standardized tests. With their parents' support, this group begins the school day forty minutes early four days a week.

The computer education program at Loma Verde Elementary succeeds in providing computer education for all children for many reasons, but two factors seem basic to its success. The first factor is a commitment to providing all children with a full range of computer experiences. All children in grades three, four, and five practice their skills regularly with the help of the computer. All children in grades three and four participate in a computer-based problem-solving curriculum. All children in kindergarten have a turn in the lab, and all children

in grades one and two use computers in their classrooms as part of their regular curriculum.

The second factor that stands out in the Loma Verde program is the ambience of the lab itself. Here children know what to do and they know what the computers are for. Without question, this is a classroom set for the real business of learning. Bilingual assistants provide an ordered, flexible structure. The intensity of children's involvement is punctuated with exclamations like, "Wow, I got it!" The whole program seems to belong to the children who treat themselves, their instructors, and their machines with dignity.

All the children at Loma Verde Elementary School have access to computers in individualized, self-pacing activities, a feature seen again in a very different program at an inner-city girls' high school:

Saint Michael's School for Girls

Imagine a sewing room in a small private girls' high school. Picture sewing machines, dress forms, ironing boards, and cupboards full of patterns, fabric scraps, pincushions, and scissors. Enjoy the nostalgia for a moment, then blink your mind's eye and replace the sewing machines with computers. Put a printer where the ironing boards stood. Replace the contents of the cupboards with software, extension cords, chip pullers, and manuals.

Now fill the room with girls, working in pairs at the computers, and you are seeing the computer lab at Saint Michael's

School for Girls. Saint Michael's is a parochial high school located in a large city. Its students, mostly Black or Hispanic, commute to school from all parts of the city.

The girls in the lab are working on accounting problems. The problems differ from group to group because the students are using a self-pacing computer-based accounting curriculum that includes software, workbooks, and textbook.

Some of these students have already taken computer literacy, programming, or word processing. Although St. Michael's has only 290 students, it offers seven electives in computing, including business uses of computers and college-level programming in BASIC. All students are required to take one quarter of computer literacy in either their sophomore or junior year.

Although ninety percent of the girls will go to college, many are from low-income families and will need to help support themselves after high school graduation. Consequently, the elective courses in business are always filled. The computer teacher, who used to work in the business world, has always presented her students with problems within a real business context. Knowing how the real world operates, she designed the curriculum to make the most of computer-assisted instruction without making wholesale changes in her program. Students move at their own rate and self-starters are rewarded, just as they will be after graduation.

Minority girls have a full range of access to computers at Saint Michael's. The computer is used as a tool for application

to real-life problems as well as for more abstract problem solving in programming classes. The computer program at Saint Michael's is designed to suit the needs of its many minority and low-income students, which include earning a living as well as preparing for college.

Another program, designed for a younger, less focused group of children, provides equitable access for youngsters in two schools at the same time:

New World Elementary School/Big Tree Elementary School

Only fourteen children attend New World Elementary School, a tiny private school in an urban area. Half of the students are limited-English speaking Asian, and all but three are girls. The school has one computer, a monitor, a printer, a modem, and a sister school, Big Tree Elementary School.

Big Tree, a rural school, has seventy-eight students, all English speaking. They also have one computer, a monitor, a printer, a modem, and a sister school, New World.

Both schools received their computer equipment and software from a computer company, with a promise that they would become sister schools and communicate through their modems.

Every Friday, children at New World and children in the fourth grade at Big Tree use their computers to write a review of a "Great Story," a classic tale either told or read by their teachers. And every Friday, they participate in a circle of interactions: The reviews fly through the phone lines, to be read, talked about, and responded to.

The activity is custom-designed for the children involved. Children from a rural environment interact with children in an urban area, most of whom are minority children from another part of the world. Children in an urban environment, many of whom have never been out of the city, interact with children from the country. All the students develop language skills as the computer becomes their only means of communication: Problems of meaning and usage are identified and solved in a real communications context.

In these schools, equitable access was solved by the application of imagination. At a large, urban school, equitable access is not quite as simple:

Marion Anderson Junior High School

A staff meeting is under way at a large junior high school located in a poor, multiethnic area of a big city. The assistant principal reports that twelve microcomputers have been delivered and asks, "How shall we use them?"

Everyone agrees that the computers should be used to help students with basic skills. Of almost 1,500 students in the school, 1,420 test below grade level in one or more areas. Staff members also agree that all children should have an opportunity to use the computers. But there are only twelve computers.

Now, suppose you have only twelve computers, 1,500 junior high students, low scores, and a commitment to equitable access to computers. What do you do?

Someone recalls having read that the most efficient use of

computers usually takes place in lab situations: Use is more constant, a lab can be kept open at noon and after school, and the size of the Anderson campus makes it difficult to wheel computers around to classrooms. The decision is made to put the computers in a lab.

But who will come to the lab? All students? Someone quickly calculates that since the school day has seven periods, and each class averages thirty-six students, only 252 students a day could come to the lab--about one sixth of the students. For the whole student body to have equal access to the computers, each class would come to the computer lab for a forty-five minute period once every six school days.

Calculations continue. Thirty-six children and twelve computers mean a ratio of three children to a computer. If students work individually, each child has about fifteen minutes on the computer once every six days. That is not a lot of time. But it's equal.

A calm voice reminds the staff that equitable access means more than equal time. It also means a full range of benefits of computer use, including the development of both basic and higher order cognitive skills as well as computer-specific skills. It means providing students with sufficient time to accomplish something that is educationally significant.

The reminder is seconded by another staff member who has read that students must work on the computer for fifteen to twenty minutes a day, four days per week, on an ongoing basis if they

are to improve basic skills. This means that the twelve computers can serve only about 250 students.

With only twelve computers, this faculty must decide between equal access for all students or equitable access for some of the students. And if only some students will have equitable access, who will they be?

The staff at Marion Anderson Junior High decides that the computers will be placed in a lab and that a seventh grade math teacher (with previous experience in curriculum development and computers) will team with another interested and willing teacher to design and test a computer-enhanced math curriculum. With two teachers keeping the lab going all day, half of all seventh graders (250 students) will be able to use computers as part of their math curriculum the first semester and the other half will have that opportunity in the second semester.

Why seventh grade? Why math? The staff wants to use the computers to present new ways to approach content and skills. The seventh grade math teacher knows Logo and has some ideas on how Logo can be used with small groups of students to develop beginning geometry concepts, part of the seventh grade curriculum. The choice of seventh grade math is made almost by default--based on the curriculum integration possibilities of available software and the interest and experience of one staff member.

Very often equitable access programs begin with (1) the delivery of a few computers for a lot of students, (2) some hard

decisions about equal access, and (3) an interested and somewhat computer-literate teacher. It helps when that teacher has supportive colleagues who help think through the logic as well as the logistics of equitable access.

Although at Marion Anderson Junior High School a computer lab serving only part of the student body seems to be the most effective way of providing equitable access, another school has found a different way to solve the problem of limited resources:

Davy Crockett Elementary School

It's Monday and the school library is full of computers and children learning about computers. Every Monday, one third of each of the fourteen classes at Crockett School come to the library at a scheduled time to learn something new on the computers and to learn how to teach the new skill or concept to the other two thirds of their own class. The librarian is their computer teacher.

It's Tuesday morning and the computers are on the move. Small companies of movers have come to the library. It's time to take a computer to class. Each classroom has a computer and the library looks like a library again.

It's Friday afternoon and the movers are at work again, wheeling computers back into the library, getting the space ready for another Monday of learning about computers.

The staff at Davy Crockett decided that they wanted to use their limited resource of fourteen computers with all the children in their own classrooms. But most of them knew very

little about computers and software. So they decided to make use of their most plentiful resource, their students, to teach themselves and other students about the computers. They designed a peer tutor program that provides equal access to computer learning not only by using computers but also by being a computer tutor.

Every child in the school participates. Each Monday a different third of each class learns something new on the computer to be taught to peers during the week; thus, each student gets to be a tutor every three weeks.

Peer tutoring provides multiple benefits at Davy Crockett. First, it provides each classroom teacher with a room full of effective computer teachers. Most of the staff knew very little about the operation of computers. Since they needed help from someone, why not their own students? They knew from previous experience that peer tutoring can be very effective. Almost 70% of the students at this school are Hispanic and many have poor language skills in both Spanish and English; thus, instruction must be presented in simple, direct language, with easily understood examples. Peers can do that well, given a little help.

On Monday, the librarian introduces something new to each group of tutors. It might be the use of a new piece of software or it might be new steps of a long-term project, like learning to use word processing software. She asks the tutors for ideas on how they might best teach the skill and together they write a

sheet of directions. She models the teaching according to the directions they have written and the tutors practice teaching each other under the eye of the librarian.

When the computer arrives in the classroom on Tuesday morning, tutors and tutees follow a schedule of computer use so that everyone gets a chance to participate. Usually a tutor works with one pair of tutees for the week. The next week, the groups change and a new tutor is in charge.

Peer tutoring works well at Davy Crockett. Both teachers and children are learning from the tutors. Everyone has equal access to being a tutor, being a tutee, and using a computer. Peer tutoring was a good choice for equitable access at Crockett. At some schools, for some students, peer tutoring is the only choice:

Whiting Middle School

Almost every week Whiting Middle School receives a few more Asian immigrant children. These children enter school with no English language ability and a turbulent history of schooling. They then become part of a culturally unfamiliar school population that is largely Hispanic. They are quiet and small, and far from home. Furthermore, hardly anyone else speaks the only language they know. Nine different languages are spoken at Whiting Middle School. These children need access to more than computers: They need to recognize themselves as an important part of their new world and they need to be recognized by others

as valuable new members of the community. At Whiting, computer access means access to a new social world.

At the request of the principal, the Whiting art teacher agreed to develop a special art course designed primarily for newcomers. The course would provide these students with experiences of success and encourage other members of the student body to develop respect for their new classmates. Given free rein, the art teacher pulled together her own interests in computer graphics and video production to offer her multilingual students a course in visual communications. She also asked to have a few well-behaved and socially adept non-immigrant students assigned to the class. By the second day of the semester the teacher, her newcomers, and the old-timers had turned the art room into a television production studio.

Every two weeks or so, the students in the special art class produce a short videotape--a tutorial on an art-making process--to be shown to all the other art classes. Every day, as soon as students arrive in the art room, they divide into production teams. Each team has a specific task to perform. One group works at an art table, developing an art skill such as paper folding or making a watercolor wash. A second group works at a single borrowed computer, using a Logo with sprites to program animated titles. A third group practices with the video camera. There is a great deal of interaction, both verbal and nonverbal, as the teacher and an aide move from group to group.

Finally the artists are ready to perform, the titles are programmed, and the camera persons know what to do. The titles are transmitted digitally from the computer to the videotape. Everyone reviews the titles. Yesss! They are indeed wonderful-- little letters jumping around the screen to spell out "PAPER BIRDS."

Now the artists fold their birds for the camera, one step at a time, with hand lettered signs indicating Step 1, Step 2, and so on. The final shot is a group of finished birds, all colors and all sizes. Attention swings back to the computer and a Logo list of the producers which will be added to the end of the video tape. The last step is a final showing, a critique, and a celebration. The tape is then ready to be shown to the rest of the world at Whiting Middle School.

As far as the newcomers are concerned, the task at hand is to produce videotapes on art-making for other students in the school. Students work in small groups on specific tasks that may change from day to day but are fairly well defined and can be learned nonverbally or with very little language. Within a real context, everyone becomes an expert as problems of production are identified and solved. And by taking control of communication technology, these students can share their work with the larger student body.

The art program is not the only program at Whiting that uses computers. All children have access to computers through a well-established computer lab which offers teacher-selected learning

with problem-solving and reinforcement software. The art program is an extra experience for children with extra needs. In this program, the computer and the video equipment are transparent--they are tools for getting a job done. The art program also gets another job done--it provides opportunities for these children to receive social recognition for their special skills.

Whiting Middle School, Davy Crockett Elementary School, Marion Anderson Junior High School, New World and Big Tree sister schools, Saint Michael's High School for Girls, and Loma Verde Elementary School all provide equitable access to computers for their students. The programs we have described provide appropriate computer access, a range of benefits, and opportunities for all children to receive social recognition for the special skills and knowledge they have developed through working with computers.

CHAPTER THREE

What About Hardware and Software?

Programs that provide equitable access to computers use a full range of hardware and software, from a single computer in a classroom to dedicated systems in a lab, from computer-assisted instruction to Logo. Computers are placed in labs, in libraries, in classrooms, and in buses; on tables, in learning centers, and on carts. Software is purchased, programmed by teachers, and borrowed from libraries. Funding comes from school budgets, district, state, and federal funds, business, industry, parent groups, community foundations, and fund raising events at schools. Each program, with its combination of hardware, software, school facilities, and other resources (including student and teacher expertise) takes on a form of its own.

This chapter provides an overview of hardware and software issues as they relate to the issue of equitable access to computers. For information on software selection in general, the reader is referred to Evaluation of Educational Software: A Guide to Guides, edited by Nancy Baker Jones of the Southwest Educational Development Laboratory and Larry Vaughan of the Northeast Regional Exchange, Inc. This invaluable guide contains

information on how to make informed decisions, raises key issues, and includes an extensive bibliography of resources.*

Hardware

The choice of computers, disk drives, printers, and peripherals is not as important to equity issues as the choice of location for that equipment. Computers can be placed in individual classrooms, centrally located in labs, or moved from class to class on a rotating schedule:

Computers in Classrooms

One elementary school classroom has two computers on tables in the corner of the room. Children in pairs take turns on a regular schedule, using basic skills software that is easy to use and takes a minimum of teacher assistance.

Another elementary classroom has one computer, a printer, and a modem. The computer is used by children who have earned three turtle stickers for having completed assigned non-computer work. On Fridays, the children use word processing software and interact with children at another school using the modem.

A junior high math class has nine work areas, each with a computer, and work table space for four students.

An art room in a junior high has a computer and a printer installed in a former supply closet, away from eraser and clay

* If you are interested in ordering this guide, please write for more information to the Southwest Educational Development Laboratory, 211 East 7th Street, Austin, Texas 78701, or phone (512) 476-6861.

dust. Students in pairs sign up for fifteen-minute turns with Logo and paint programs.

In a business education class, ten computers from varying manufacturers and an assortment of printers make up a mock office behind a low partition. The rest of the classroom has traditional desks for "off-line" work.

A career counseling program for disadvantaged youth has three computers and letter-quality printers in a small room; the young adults use this equipment to write job application letters and resumes.

Computers in Labs

An elementary school computer lab has fourteen work stations, each with room for a pair of students. A printer is attached to one computer. Children work independently using software selected to meet individual needs. The lab, staffed by an aide, is used before school by children who need extra practice with basic skills, at noon by a school computer club, and after school by a supplementary migrant education program.

Across town, a senior high school houses one of the district's two mainframe computers. Twenty-four terminals for students' use are networked to the big computer. Unfortunately, the mainframe's software was not developed with the educational needs of youngsters in mind, so these terminals can only be used for the system's original applications--word processing, spread sheets, and data base management. Fortunately, the high school

also has a lab with independent microcomputers, which can be used in a variety of ways.

A junior high lab has twenty-four microcomputers networked to a hard disk storage system. Students don't boot their own software, but choose from a menu of programs held in memory on the hard disk. The computer teacher has a computer and a large screen for demonstrations, also networked to the hard disk. Teaching on this system is limited by the availability of software licensed for use on the network. The school also has fourteen computers on carts available for use in individual classrooms.

A public library has a room with seven computers and printers, available on an hourly basis to library patrons. A librarian checks out software, manuals, and keys to the computers. A volunteer staff of highly interested youngsters offers help and keeps the computers occupied in off-hours!

Computers on the Move

A school library houses a dozen computers on rolling carts. On Monday, a few students from each class come to the library to learn a new skill, which they will teach to their peers in their own classrooms. On Tuesday, the computers are rolled to classrooms, where they stay the rest of the week; on Friday afternoon, students roll the computers back to the library.

A computer lab is home for eight computers on carts in addition to fourteen resident computers. Teachers sign up to use one of the mobile computers, and an upper grade student aide

delivers it to the classroom, boots the software, and answers simple operational questions.

The ultimate mobile cart is a bus. In a community of migrant farm workers, a computer bus rolls into a neighborhood or camp one evening a week for a parent education program. A generator provides power for the computers and for lighting.

Software

What children see and do with computers is largely a function of software. Three questions to ask about software are: Instructional functions--What does it do? Affective qualities--How does it make students feel? Ease of use--Is it "user friendly"?

What Does the Software Do?

The functions of educational software can be divided into three general categories: computer-assisted instruction on basic skills or concepts, development of problem-solving skills, and applications.

Computer-assisted instruction. Software for computer-assisted instruction (CAI) provides information and instruction in subject areas such as math, language arts, English, science, social studies, and foreign languages. Some software provides drill and practice in basic skills such as punctuation or addition. Other software provides information on a specific topic, such as earthquakes, followed by a sequence of questions

and answers in tutorial form. Examples are "Circus Math" (MECC), "Construct a Word" (DLM), and "Dinosaur Dig" (CBS).

Since the software is designed for instruction or reinforcement of discrete skills and specific academic content, the objectives of computer-assisted instruction are usually clearly stated in documentation (manuals and teachers' guides). Some software measures student success in meeting the objectives, provides corrective feedback and positive reinforcement, and records student progress.

Computer-assisted instruction is best used as an instructional support tool, for enrichment and for developmental or remedial instruction. It can be a highly motivating alternative approach to basic skills development for some children.

Problem-solving software. Problem-solving software is a term we use for a broad range of software that attends to the improvement of problem-solving or thinking skills. Some of this software is designed specifically to stimulate and promote the development of children's thinking processes in what the designers feel is a systematic, orderly manner. One example is a series published by Sunburst which includes "Memory: The First Step in Problem Solving" and "Discrimination, Attributes and Rules: The Second Step in Problem Solving" for grades K-6.

Other software packages, not as specific in their objectives, provide learning environments with a potential for the development of thinking and problem-solving skills. Logic games

such as "Rocky's Boots" (The Learning Company) are an example of this kind of software. Another example is simulation software like "Seven Cities of Gold" (Electronic Arts), which requires students to solve explorers' problems if they are to discover a new world (and learn the history and geography of the Americas). Other types of software encourage students to use imagination and visualization, such as "I Can Be Anything" (IBM).

The most open-ended thinking/problem-solving environments are provided by programming software like "Karel the Robot" (Cybertronics and IBM) and the various versions of Logo. Logo, a graphics programming language for children, promises to stimulate children's development of cognitive skills and engage them in experiential learning. One claim made for Logo is that when children program the computer to perform an operation, they learn the task's underlying logic. It has been observed that children writing programs in Logo are, by the nature of the task, encouraged to use systematic thinking and planning skills.

Although claims made for problem-solving software may be clear, the open-ended nature of this software means that the objectives it meets depend on the focus of the teaching that accompanies its use.

Applications (tools). Applications software provides access to a whole range of computer operations such as word processing, the use of spread sheets, and data base management. Some applications software is designed specifically for student use, like "Bank Street Writer" (Broderbund), a word processing program

for beginners. Most often, however, applications used in schools are the real thing--adult software tools designed for a wide range of purposes.

Software companies are beginning to publish materials for teachers that include the use of applications. For example, the program "I Can Write" (Sunburst) provides a creative writing curriculum, complete with a teachers' handbook and 25 files (lessons) on diskette to go with an elementary word processing software package, "Magic Slate" (Sunburst). The curriculum blends traditional language arts objectives with imaginative writing exercises to introduce youngsters to word processing as well as to creative writing. The writing lessons are written for each grade level and range from open-ended explorations of a student's world to more formal language objectives, such as (in grade two) changing a monster's description with new adjectives or commanding its actions with different verbs. When students complete all of the files, their collected work may be assembled into a bound book--a record of what they've learned and written. The teachers' guide includes warm-up writing exercises, teaching strategies, discussion topics, and student examples. It also suggests activities for enhancing and expanding the concepts taught.

An applications program published for high school business classes, "Microcomputer Activities for Recordkeeping" (Houghton Mifflin) uses spread-sheet software. Again, this software is an application and its use is embedded in a curriculum. Both of

these software packages are examples of how applications software can be used in traditional curricula.

Computer-assisted instruction, problem-solving software, and applications software can each be used appropriately in computer programs for all children. However, we need to guard against overusing computer-assisted instruction with low-achieving students. It is very attractive in its promise to help with basic skills and is often relatively easy to use without teacher assistance, providing teachers with valuable time for other activities with children. But computers for all children means access to the broad range of benefits that can be provided through computer use, and that includes the use of problem-solving software and applications software as well as computer-assisted instruction.

How Does the Software Make Students Feel?

Students probably won't choose to continue to use computers unless the experience is comfortable and provides them with a sense of accomplishment.

The software feels comfortable. Software, like shoes, ought to fit. Software that is biased toward boys, or only one race, or culture, or achievement group feels uncomfortable--it doesn't fit.

- o Software that shows only boys or that portrays girls as bystanders doesn't fit girls who like to be involved.

- o Software that shows only one race or culture is uncomfortable for students who are left out.
- o Software that moves along too fast or too slowly or down paths students wouldn't choose for themselves is uncomfortable.
- o Ideally, software and documentation that fit are written in one's native language. Learning the language of a computer is difficult enough without having the language on the screen also be unintelligible.
- o Some students enjoy competition and like software that sets up situations in which they compete against themselves or others. Other students don't like to be competitive. They would rather work cooperatively with their peers.
- o In general, software that displays violence or rewards correct responses with the destruction of a monster or with a chance to shoot down an alien ship is not comfortable for everyone.
- o Students who want to work with peers may not feel comfortable with software that allows for only one user at a time. Others are perfectly happy working independently. Some students like to direct their own learning and work well in an open-ended discovery situation, while others are more comfortable with models or structures that act as guides to discovery.

Software that fits all children is free from sexual, racial, cultural, and economic bias. It allows for differences in learning style so that students can have more or less structure, work independently or in groups, and choose competition or cooperation. It respects differences in ability. It fosters creativity. It allows students to be themselves.

The software provides for a sense of accomplishment. Good software has clearly stated objectives so that students and teachers know what it is supposed to do. The objectives should be relevant to instructional goals and perceived by students as worth meeting. And when the objectives have been met, students should feel a sense of accomplishment.

A sense of accomplishment is a feeling that a task has been done successfully. It's a positive awareness of completion. Software that provides for a sense of accomplishment has some of these characteristics:

- o The tasks presented by the software are valued by students.
- o Tasks form whole experiences--students are aware that they have completed something, that the experience has come to a close.
- o The software responds to student input positively, even when the student has failed to make an appropriate response. The software is nonjudgmental, friendly, and patient.

- o Students feel an honest, realistic sense of accomplishment. Rewards for success motivate students to continue with their good work without being excessive.
- o Scoring is used only when students have ample opportunities to score well--when students or teachers may choose an appropriate ability level so that some degree of success and a sense of accomplishment can be expected.
- o Different students can find success in different ways--the software is either open-ended or provides branches into different levels or areas of content.

Is the Software "User Friendly"?

When we say that software is "user friendly," we're talking about software that is easy for the student to use. Students move through the learning activities without stumbling over the mechanics of computer use. Characteristics that make software easy to use are:

Operations

- o The software is free from operating problems: It always works!
- o Software "boots" itself--it starts when the computer's power is turned on (cold boot) or with a simple sequence of keystrokes (warm boot).

- o If the software "crashes," or ends itself, an instruction for continuing appears on the screen.
- o A cursor or arrow shows the user where an entry will go.
- o Keys that aren't used in the program have no function other than to produce a soft error beep when pressed.
- o The amount of typing is appropriate for the grade level.
- o Commands and keys are used consistently. For example, pressing the escape key always takes the user back to the menu rather than sometimes erasing an answer.
- o Students can correct errors.
- o From any part of the program, students can (1) get help with instructions on the screen, (2) return to the menu, and (3) end the program. Basic instructions are on the screen or are just one keystroke away from view.

Language

- o Grammar, punctuation, and spelling are correct.
- o Users' guides (manuals) are clearly written for students.
- o For non-English speaking students, instructions, commands, and users' guide are in their native language.
- o Instructions for getting started are very clearly listed on the package or on a command summary card. All other operating instructions and commands are summarized on a

card or single page in a guide.

- o The software provides a "menu" of choices for students, and if the software is for young children, the menu has pictures.

Pedagogy

- o Teachers and students can change the speed or route of the presentation of material.
- o Teachers can edit and/or translate instructions in the program.
- o Suggestions for instruction and for integrating software with existing curriculum are provided.

Mechanics

- o Alternate input devices such as touch pads and joysticks can be used in place of the keyboard.
- o Sound can be turned off.
- o Backup copies of the software can be made.
- o If a separate data disk will be needed, the program makes it easy for students to initialize a disk and reminds them to place it in the disk drive when needed.
- o Screens are free from visual clutter so that students can

see the information needed and the choices available at the moment.

Remember that a single computer experience will not meet all the criteria we have discussed. Software may not be designed with all the affective factors in mind, nor be equally accessible to all students and teachers. The lists in this chapter are provided only to help with choices--they are not to be seen as prescriptive. And if software that meets just a few of these criteria works in your situation, continue to use it!

CHAPTER FOUR

What Do Children Need for Equitable Access?

Children receive many benefits when they are provided with access to computers. They learn about computers. Many routine learning tasks become more interesting and challenging. Problem-solving software encourages the development of children's thinking skills, and through simulation software, children are exposed to new worlds of experience. The computer can also serve as a catalyst for personal and social development.

But for all these things to happen, children need help. They need help with the mechanical, conceptual, and social aspects of computer use.

Help With Mechanics

Beginning computer users need help getting started with even the most easy-to-run software. They need to know how to handle diskettes, how to open the disk drive, how to turn on the machine, and so on. More advanced students need help with such tasks as making data disks, saving files, and following more complicated sets of instructions.

Teachers can help with the mechanics first of all by selecting software according to the criteria that we discussed in the preceding chapter. In particular, software should be easy to use, free of programming errors, and accompanied by clear and

complete instructions. The operation of the software should be almost "invisible" so that the student can pay full attention to the subject matter being presented.

However, good software is not sufficient in itself to provide a satisfying computer learning experience for children. It must be accompanied by nonthreatening, step-by-step instruction. One good way to provide effective instruction is through peer tutoring.

By peer tutoring we mean allowing students to help one another, usually on a one-to-one basis. (Other forms of tutoring that have been used effectively in some programs consist of students tutoring teachers and parents--don't overlook students as resources, as the two-way academic and social benefits can be positive.) The advantages of peer tutoring are:

- o Peers provide one another with individualized instruction.
- o The simple, direct language and familiar examples used by peers are effective in reaching youngsters.
- o Both the tutor and the tutee learn.
- o Students tend to be very direct with each other, especially when an atmosphere of trust has been established.
- o Peer tutors are apt to remember their own difficulties with computers and can help less experienced users anticipate problems.

A good example of the use of peer tutors is the Peer-Managed Computer Training Program designed and implemented in 1983 by CREATE (Center for Research on Equitable Access to Technology in Education) at Far West Laboratory in San Francisco (see Crist-Whitzel, Dasho & Beckum, 1984). The project hired several computer-literate high school students to develop a computer programming curriculum and teach BASIC to a group of students from an inner-city high school. The objectives of the program were to provide access to computers for students who would not ordinarily have the opportunity or the interest to learn about computers, demonstrate that students could effectively provide computer training to their peers, show that low-achieving and low-income students who do not have the typically required math courses could learn to program computers, and develop a training program that could be implemented elsewhere.

Groups of ten to twelve students met for two-hour sessions three times a week for about six weeks. Five student trainers took turns giving short presentations on BASIC programming topics such as statements, commands, and flow-charting. Those not teaching a particular lesson circulated as tutors among the students, who typically worked in pairs.

By the end of the program, most students were able to write successful computer games or other programs with the help of the trainers. Students reported greater interest in computers as a result of taking the class and they liked having other students as their teachers. They particularly appreciated having several trainers so they could get help faster.

Here are some guidelines for the use of peer tutoring:

- o Let students help plan the program.
- o Establish regular schedules.
- o Assign specific tasks.
- o Provide clearly written directions.
- o Have all students in the classroom participate both as tutor and tutee.

To get started with peer tutoring:

- o Set aside time for student planning and for training.
- o Model the tutoring behaviors.
- o Let parents know what you are doing.
- o Let everyone know that we all learn from one another.

Help With Concepts

Once children have mastered the mechanics of using computers, they still need help learning the concepts presented by the software. In any well-designed software all directions, definitions, or references to concepts or skills are clear, concise, and available on the screen. Still, computer use should most often be accompanied by off-line instruction. Some students may also need supplementary materials like worksheets or command summary cards.

Although children may need help learning the concepts presented in all types of software, they usually need less help when using computer-assisted instruction than they do with problem-solving software. Computer-assisted instruction presents discrete skills to be practiced and specific ways to practice them; therefore, clear directions are easier for the teacher to provide.

Problem-solving software presents open-ended situations in which students are expected to develop systems of thinking and problem solving. In these higher level uses of computers, students themselves identify which skills to practice and concepts to explore. Some children need help with the open-endedness of these experiences. For example, research on the learning styles of Mexican-American children has shown that these children have somewhat different learning styles from middle-class white students. Children who are raised in a traditional Mexican-American community with strong cultural and religious ties, associate with and identify with others of Mexican heritage, and use Spanish as their primary language tend to learn best when the content to be learned has built-in structure. They are not as comfortable in situations in which they need to analyze and structure their own material. To make the most of an open-ended learning environment (such as the one provided in Logo software) these children will need a curriculum that provides some measure of structure.

Low-ability learners need even more systematic instruction if they are to have access to open-ended problem-solving software. Some educators would argue that systematic instruction designed

around open-ended software negates the objectives and/or effectiveness of the learning experience. We believe, however, that it is possible to provide structure that does not interfere with problem-solving and discovery processes.

A five-step process (Sharp, 1984) for providing unobtrusive structure to open-ended learning experiences is:

1. Identify a concept or skill that students will probably encounter when engaged in the use of the problem-solving software. Define it for yourself. Find instances in your own life when you employ the skill or use the concept. Imagine instances in your students' lives when they will encounter the skill or concept.
2. Set the stage. Create an environment of problems in which students will need to use the concept or skill.
3. Anticipate what you might see. Know that children will "discover" the concept or recognize their own use of a skill in different ways. Think of children you have known and how they have used the skills or concepts.
4. Think of what you will say. The way we talk directs children's thinking. Plan how you will respond to the children's involvement. Be prepared to present analogies to real life situations.
5. Provide multiple activities for practicing the new concepts or skills.

Help With Social Development

In addition to help with mechanics and concepts, children need help with the social aspects of computer use. Many of the groups we have been talking about face social barriers when they try to work with computers. These barriers include self-perceptions of low status, lack of encouragement from others, and a lack of awareness on the part of school staff that such barriers exist. To overcome social barriers, students need:

- o Role models in the school staff, among peers, in the community, and in commercial advertising that include women and members of minority groups as computer users.
- o Peer models from a wide range of respected social groups that might include athletes, average students, and members of a rock band.
- o Encouragement by school staff to take computer courses and to consider careers in computer fields.
- o Encouragement for all students to belong to computer clubs and to drop into the computer room at noon and after school.
- o Clear evidence of the worth of computer learning for all students. This may require instruction in social studies, math, or English classes on the important uses people have found for computers in their lives. It may also mean tailoring courses to meet the perceived needs of students.

- o Special help with self-image and status.

As we described above, peer tutoring is especially valuable in computer learning. Activities for peer tutoring or small groups can help all students with their image of themselves as competent computer users.

Students' self-esteem can be enhanced in group work through use of several strategies (Cohen, 1986):

- o Develop cooperative norms in the classroom. Make it clear that everyone has a right to participate, that we all learn from one another, and that everyone helps each other.
- o Equalize interaction as much as possible by giving every student a specific role or responsibility that may not be taken by others. Rotate those responsibilities. Change the membership of groups periodically.
- o Help low-status students become group experts. For each child find a task in which that child is already an expert or give extra help so he or she can become an expert in a new task. Help the low-status student become a competent teacher of that task.
- o Help students recognize that everyone has different skills and talents to contribute to the group, and that many of these abilities are not included in the standard areas of reading, writing, and doing math.

- o Help low-status students see their own good performance.

All children need help in learning to work with computers, but help is especially important for students who are less likely to see themselves as computer users. These children need not only easy-to-use software, but also careful teaching to make sure that their experience with computers is a comfortable and productive one that increases their self-esteem and feelings of competence. They need help in learning how to use the computer, help in mastering higher level as well as more routine concepts, and help in overcoming the social barriers that hinder them from using computers successfully.

CHAPTER FIVE

What Can Schools and Communities Do To Establish Computer Programs for All Children?

If all children are to have equitable access to computers, present practices must be changed. The responsibility for that change can be shared by all--teachers, administrators, parents, and community members.

Teachers are probably the most important agents of change. In order to take responsibility for providing equitable access, they will need to:

- o Become sensitive to the issues regarding equitable use of computers and keep these issues in mind when planning for computer use in classrooms.
- o Develop a support group of colleagues and out-of-school friends who can answer the simplest questions as well as discuss the deepest issues of computer use for all children.
- o Allow themselves to experiment and to make mistakes.
- o Accept help, even from students.
- o Assist colleagues with observation, evaluation, and feedback regarding computer use.

- o Make information on the computer needs of all children available to other members of the educational community.

To help teachers carry out the change process,

administrators, parents, and community members can:

- o Provide information on equitable access issues and a forum for the discussion of those issues.
- o Understand that teachers and their students are undergoing a process of change. Giving all children access to computers is not an event, but rather a process that may take several years.
- o Outline clearly and honestly what teachers will need to do.
- o Hold realistic expectations of teachers and be aware that teachers' interests, skills, and available time will differ.

Administrators at both the district and building levels can use their special skills to:

- o Make it very clear that a problem exists and that everyone has a role in finding and implementing solutions. Ways that administrators might do this include collecting data on computer use and attitudes among children and adults in the community, providing informational and

planning workshops, and disseminating information on the problem and possible solutions throughout the community.

- o Create working environments that emphasize learning for everyone--teachers, administrators, parents, and community, as well as students.
- o Insure that computer committees include teachers, parents, and students who represent all subject areas and teaching levels.
- o Initiate and support long-term planning for the integration of computers into curriculum, for teacher training, and for software and hardware purchasing.
- o Set a realistic pace for change while maintaining a steady commitment to the task.
- o Supply in-service training on software and hardware.
- o Attend some of the training workshops with teachers.
- o Provide teachers with time for hands-on practice with computers, for curriculum development, for reflection on computer experiences, and for collegial interaction.
- o Remember that teachers are learners too and that teachers' centers and mentor teacher programs can be very effective in helping teachers develop new skills.

- o Encourage staff members to join professional computer education groups at local, county, state, and national levels.
- o Develop a network of administrative colleagues who are concerned about similar equity issues.
- o Support projects developed at school sites to meet local needs.
- o Allow for classroom and building-level adoption of materials and equipment in the early stages of change. This means that the people who will be using the hardware and software can develop a substantial fund of experience that districts can tap in making decisions on the "best" materials to purchase.

Business and industry can:

- o Make professional resources available to schools at both planning and implementation stages of computer use.
- o Provide role models for youngsters.
- o Financially support school computer programs that serve all children.

Parents and other community members have special responsibilities to:

- o Keep themselves informed of the issues, problems, policies, and practices of computer use in their schools.
- o Serve on planning boards, as classroom volunteers, and spokespersons for all children.
- o Support the computer-related endeavors and aspirations of their children and the school community.

Everyone has an important role to play if we are to have computers for all children. The whole educational community-- teachers, administrators, parents, and other community members-- must pay attention, reflect, and act. Computers have an enormous potential to change our lives and our society; whether or not everyone benefits depends upon us.

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OTHER SELECTED RESOURCES

Equitable Access to Computers

Other Selected Publications (See Introduction for list of publications from the Far West Laboratory)

Computers, Equity, and Urban Schools. (1985). Educational Technology Center, Harvard University.

This booklet is a report of an invitational working conference, held in November 1984 at the Educational Technology Center, to explore issues pertaining to uses of educational technology in urban schools and to recommend steps toward policy and program development.

The Computing Teacher, theme issue on computer equity. (1984, April). The Journal of the International Council for Computers in Education.

This entire issue was devoted to articles about equity and computers by a variety of authors. Articles pertain to an overview of the issues, as well as research and practical ideas. It is a good introduction to and overview of computer equity and some of the people and organizations who are concerned about it.

Other Selected Organizations Involved with Computer Equity

Center for Educational Equity, American Institutes for Research.
P.O. Box 1113, Palo Alto, CA 94302, (415) 493-3550. Contacts:
Jane Schubert, Jean Wolman.

The Center for Educational Equity, funded by the U.S. Department of Education, promotes sex equity in educational programs in Arizona, California, and Nevada, in collaboration with local education agencies. Project SEE (Sex Equity in Education), in cooperation with the CA State Department of Education, provides staff development and training for integrating computers in education.

SISCOM, funded under the Women's Educational Equity Act (WEEA), is a collaborative project with Big Brothers/Big Sisters to provide a co-learning approach to computer competence for Big and Little Sister pairs and is aimed at disadvantaged young girls from single parent homes.

Ideas for Equitable Computer Learning is a resource packet published by the Center for Educational Equity to help educators improve computer learning opportunities for all students. Instructional strategies are suggested for lowering barriers to computer access and use.

Computers in Schools Project, National Commission on Industrial Innovation, 1125 West Sixth St., Suite 300, Los Angeles, CA 90017, (213) 481-0205. Contact: Judith Johns Hubner.

The Computers in Schools Project has a primary concern for equitable access to technology in education, with a special interest in the area of telecommunications. The project sponsors periodic meetings with representatives of major educational groups in California and undertakes special projects promoting exemplary uses of computers in schools.

Council of Chief State School Officers Resource Center on Educational Equity (CCSSO), 400 North Capitol St., N. W., Suite 379, Washington, D. C. 20001, (202) 393-8159.

This resource center maintains concerns and projects dealing with a variety of equity issues and publishes Concerns, a newsletter about educational equity issues. Issue XII, June 1984 focused on computer equity.

Educational Products Information Exchange (EPIE), 4-C Project, P.O. Box 786, Kenwood, CA 95452, (707) 833-4621. Contact: Richard Wenn.

The Community-Classroom Computer Connection (4-C) project is a cooperative program with the MESA (Mathematics, Engineering, Science Achievement) program at the University of California-Berkeley Center and area middle and junior high schools to provide urban minority students and their families with the skills they need to use computers at home for educational activities. The program provides instruction to parents and students and a checkout program for using computers at home. EPIE also maintains an online database on CompuServe focusing on equity and technology.

EQUALS in Computer Technology, Lawrence Hall of Science, University of California, Berkeley, CA 94720, (415) 642-1823. Contact: Kay Gilliland.

This program offers inservice education to educators to increase their awareness of the importance of females' acquisition of technical competence. It provides practical classroom strategies and materials that (1) encourage girls and minorities to enroll in computer courses, (2) help develop thinking skills in areas necessary for technical work, and (3) provide experiences and information that will enable students to master technology.

Hispanic Education and Technology (H.E.A.T.) Network, School of Education, Stanford University, Stanford, CA 94305, (415) 497-1297. Contacts: Beatriz Arias, Liza Loop.

This project is an effort to link together, especially through electronic networking, educators and researchers concerned with equitable access to technology in education for Hispanic students. Its aim is to study the patterns of dissemination of educational computing and other technology to the Hispanic community.

Mathematics, Engineering, Science Achievement, Lawrence Hall of Science, University of California, Berkeley, CA 94720, (415) 642-5064.

MESA is designed to increase the numbers of underrepresented minorities (especially Blacks, Chicanos/Mexican-Americans, Puerto Ricans, and American Indians) in mathematics-, engineering-, and science-related professions. Participating students receive educational enrichment and practical help needed to prepare for university-level programs. Computer training programs are included as a component in various MESA programs, especially during the summer.

Project on Equal Education Rights (PEER), 1413 K Street, N.W., Ninth Floor, Washington, DC 20005, (202) 332-7337. Contact: Leslie R. Wolfe.

PEER, a project of the NOW Legal Defense and Education Fund, focuses on a computer equity agenda that includes synthesizing current research and programmatic efforts, making an original contribution, publishing new reports and action kits, and identifying and publishing exemplary state and local computer equity programs.